Exemption No. 5587D

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

Jetstream Aircraft Limited

for an exemption from §§ 25.562(c)(5) and 25.785(a) of the Federal Aviation Regulations

Regulatory Docket No. 27001

PARTIAL GRANT OF EXEMPTION

By letter AWP/J41/250/960672 dated September 18, 1996, R.D. Evans, Chief Airworthiness Engineer, Jetstream Aircraft Limited (formerly British Aerospace Regional Aircraft Limited), Prestwick International Airport, Ayrshire KA9 2RW, Scotland, petitioned for an extension to Exemption 5587C regarding the Head Injury Criterion (HIC) of §§ 25.562(c)(5) and 25.785(a) of the Federal Aviation Regulations (FAR), for front row passenger seating in Jetstream Series 4100 airplanes, until December 31, 1997. The existing exemption expires on December 31, 1996.

Sections of the FAR affected:

Section 25.785(a) requires that each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of those facilities will not suffer serious injury in an emergency landing as a result of inertia forces specified in §§ 25.561 and 25.562.

Section 25.562(c)(5) requires that each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Impact Criterion (HIC) of 1,000 units. The level of HIC is defined by the equation:

$$HIC = \left[(t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)\, dt \right]^{2.5} \right]_{max}$$

The petitioner's supportive information is as follows:

"**1. SUMMARY**"

"On 12th December 1995, Jetstream Aircraft Ltd (JALtd) were granted Exemption 5587C which extended an existing exemption against FAR 25.562(c)(5) and FAR 25.785(a) until 31 December 1996.

"On behalf of Jetstream Aircraft Ltd, holder of FAA Type Certificate A41NM, and in accordance with 14 CFR Part 11 Section 11.25, I hereby petition the Administrator for a further temporary extension of that same exemption until 31 December 1997.

"JALtd request a further extension of the termination date of Exemption 5587C until 31 December 1997. Exemption 5587C grants relief from compliance with the Head Injury Criteria of FAR Part 25 for the front row passengers of the Jetstream Model 4101 airplane until 31 December 1996. This further extension is sought to allow JALtd to deliver new airplanes with an economically viable seating configuration whilst JALtd pursue the design, development and certification of a front row passenger protection system using air-bags."

"2. PROPOSED AMENDMENT

"JALtd propose that the expiry date of exemption 5587C be amended from 31 December 1996 to 31 December 1997.

"3. INTERESTS OF THE PETITIONER AND PUBLIC

"a) JALtd is the manufacturer of the Jetstream Model 4101 airplane and the holder of FAA Type Certificate A41NM. JA Ltd is pursuing marketing opportunities for J41 airplanes for delivery to U.S. Operators during 1997. These airplanes cannot be delivered with an economically viable seating configuration without relief from the cited rules. JALtd will suffer serious financial consequences should it be unable to deliver airplanes on the scheduled dates.

"b) U.S. operators will suffer serious financial burdens should they be unable to introduce into service new airplanes with maximum seating capacity on the dates scheduled.

"i) Operators plan their operations on the assumption that the specified seating configuration will be available.

"ii) Delivery of airplanes with the front row seats unavailable for use would seriously degrade the operating economics of the airplane by reducing the achievable revenue but without any possibility of a proportionate reduction of the operating costs.

"c) The traveling public would be adversely affected by a reduction in the available seating capacity.

"i) Some peak-time travelers would be denied transportation because the demand for seats on popular flights would exceed the number planned to be available.

"ii) An increase in the cost of airfares would be necessary to re-establish the economic viability of the operation. If this option was judged to be unacceptable then withdrawal of the service could ensue. Neither of these possibilities would benefit the traveling public.

"4. <u>SUPPORTING INFORMATION</u>

"a) JALtd has applied for, and been granted, temporary exemptions from the cited FAR 25 paragraphs on four occasions since October 1992 :-

"i) Exemption 5587 dated 13 January 1993, granting relief until 31 December 1993.

"This exemption was granted prior to Type Certification of the Jetstream Model 4101 on 9 April 1993 and in anticipation that an acceptable solution would be developed before the exemption expired.

"ii) Exemption 5587A dated 29 December 1993, extending relief until 31 December 1994.

"This extension to Exemption 5587 was granted in acknowledgement of the difficulty that JALtd was encountering in developing and proving "passive" protection systems.

"iii) Exemption 5587B dated 20 December 1994, extending relief until 31 December 1995.

"This extension to Exemption 5587 was granted to allow JALtd time to develop an "active" air-bag protection system following the JALtd realization that, despite persistent efforts, "passive" protection systems were unlikely to yield a satisfactory and acceptable solution.

"iv) Exemption 5587C dated 12 December 1995, extending relief until 31 December 1996.

"This extension to Exemption 5587 was granted to allow JA Ltd further time to develop an airbag protection system, whilst the FAA and JAA were still

formulating their Special Conditions, some of which impacted on the programme.

"JALtd acknowledges the safety benefits of the rules and remains committed to developing an acceptable solution which provides passengers with the protection intended by the rules. However, the development time for the system has proven to be longer than predicted and consequently a further temporary extension of the compliance date is sought.

"JALtd, working with Simula Government Products Inc, has been and is continuing to actively develop a passenger head protective system using inflatable airbags similar to those in common use in the automotive industry. JALtd's progress with this development program has been regularly reported to the FAA as required by exemption 5587C.

"b) Exemption 5587C contains the following conditions :-

"i) That JALtd submit quarterly progress reports to FAA outlining progress and future planned activities.
JALtd has complied with this condition, the third report being due at the end of September 1996.

"ii) That JALtd submit a schedule for the retrofit of the design solution to the fleet prior to the expiration of the exemption.

"JALtd will be unable to submit a meaningful retrofit schedule because:-

"(1) The design solution has not been finalised.
Supply of the systems for shipment to and installation in affected airplanes cannot occur until the design is complete and compliance with the special conditions has been demonstrated. Furthermore, the airplane down-time required to install the system cannot be accurately determined until all details of the installation have been finalised.

"(2) The retrofit schedule will depend on the location of the airplanes and the fleet availability requirements of the operators.
The co-operation of, and co-ordination with, the operators will be necessary. Whilst JALtd have no reason to expect that the disposition of the fleet will change during 1997, any major changes could have a significant impact on the schedule. Each operators fleet size, utilisation schedule, and required airplane down-time all have a significant effect on the overall retrofit schedule.

"JALtd therefore submit that attempting to formulate a schedule before the first quarter of 1997 is premature.

"c) In the granting of Exemption 5587C the FAA make some observations relevant to this application :-

"i) *". . . the installation of air-bags on airplanes (is) a novel and unique feature, (which) will require the development of special conditions . . ."*

"JA Ltd has received the FAA Special Conditions in April 1996 and one of the conditions (No.3) make reference to satisfying special conditions 25-ANM-48 which deals with HIRF/Lightening. It is this special condition No.3 that has had further impact on the programme since the airbag vendor Simula Government Products has had difficulty in obtaining supply of a HIRF resistant in-line connector to the gas generator. This has resulted in the dynamic testing being put back to November 1996 with the whole programme slipping to May/June 1997 completion.

"ii) *". . . the air-bag . . poses a complicated certification problem and should be fully developed before it is implemented. . ."*

"JALtd agree with the FAA that the problem is more complicated than originally envisioned when JALtd committed to the air-bag solution and anticipated having a system available by the end of 1996.

"JA Ltd are equally concerned that the airbag system must be fully developed before it is implemented and propose that after the system installation is certificated but before the system is installed on aircraft in airline service the system should be installed on a Company communications Jetstream 41 aircraft and flown for a period of nine months in representative passenger operation.

"The following significant factors were also highlighted in the previous petition are still relevant to this petition. These are repeated below.

"(1) In developing guidelines and design specifications, JALtd and Simula have been drawing on the experience gained with air-bags in the road transport sector. Comparison between automotive and aviation applications has revealed significant differences that lead to the aviation application being more difficult to solve.

"(a) Automotive passengers are generally always seated upright, facing forward and wearing a shoulder restraint. The air-bag is regarded as a supplementary head restraint system.

"Airplane passengers will not be wearing a shoulder restraint and consequently the air-bag will be the primary head protection system. Shoulder harnesses are not available in airplanes used for scheduled services due to adverse traveler opinion.

"(b) Automotive accidents occur in a very short timeframe with passengers having no time to prepare for impact.

"Aviation accidents in which air-bags may be expected to fulfill their intended purpose are usually preceded by enough time for passengers to prepare themselves for impact. Airplane passengers may either be seated upright or adopting the brace position. Passenger safety considerations dictate that air-bag deployment while the passenger is in the brace position must be shown to be non-hazardous and this factor imposes an additional constraint on the design of the system that is not duplicated in the automotive field.

"(c) There is a larger distance between the bulkhead mounted air-bag and passenger in an airplane than there is in a road vehicle. This larger distance is technically very significant and has contributed to the difficulty in resolving the head-strike problem.

"(d) Motor vehicle accidents are likely to occur at any time that the vehicle is in motion and automotive air-bag systems therefore must be enabled and ready for deployment at all times.

"Although airplanes are exposed to the possibility of ground-impact accidents at all times while airborne, the air-bag system needs to be available for only a relatively short period during the take-off and landing phases of each flight. In order to reduce the possibility of injury to occupants by inadvertent in-flight deployment of the air-bag, a deployment control system that suitably limits the period when the air-bag is available for use may be necessary. Such control systems are unnecessary in road vehicles.

"d) JALtd is also pursuing JAA certification of the proposed air-bag system for installation in airplanes certificated in accordance with the JAA certification basis.

"In accordance with JAA policy applicable to all aircraft types which are subject to JAR 25.562(c)(5) and JAR 25.785(a), the JAA have exempted the Jetstream 4100 from compliance with these requirements until 1st January 1997. JA Ltd have applied for a further exemption until 31 December 1997.

> "The JAA are also developing special conditions and associated acceptable means of compliance for the passenger air-bag system. The FAA and JAA have been conferring on the matter of certification requirements for air-bag systems in an attempt to achieve a common approach to the problem and there is general agreement between FAA and JAA on the technical issues and submit that a common compliance date is consistent with the Harmonisation objective."

A summary of the petitioner's request for an extension to Exemption 5587C appeared in the Federal Register on October 25, 1996 (61FR55354). No comments were received.

The FAA's analysis/summary is as follows:

Exemption 5587C was issued with the intent that it would be last such extension of compliance with the requirement for front row HIC. The FAA concurred with the petitioner's December 31, 1996, requested expiration date for that extension, as appropriate to allow sufficient development time without unduly delaying implementation of this new safety requirement benefiting passengers seated behind bulkhead structures.

The FAA still considers that Jetstream Aircraft has been making a good-faith effort to observe the terms of that exemption, having engaged in developmental efforts and by documenting this activity in quarterly status reports. The principal reason for requesting this further extension is that the development of the airbag system chosen to achieve compliance has not progressed as rapidly as hoped. In addition, there has been a supplier parts problem that has caused a schedule slippage.

The bulk of the requested extension time, however, appears to be due to the nine month functional flight time on a company aircraft. While the FAA agrees that such "service experience" is useful, it would seem that the critical information could be gathered in a more expeditious manner. That is, installation of the actual inflatable is not necessary to evaluate the integrity of the activation circuitry. Thus, an existing, in-service airplane could be used for this purpose, without introducing any potential hazard to the airplane or its occupants. This would allow the information to gathered much more quickly than on a company airplane.

The FAA continues to believe that the airbag has the potential to provide a level of safety even greater than that required by the rule, and thus is interested in seeing its development come to fruition. Nonetheless, since the granting of Exemption 5587C, one manufacturer has installed upper torso restraints as a means of compliance with front row HIC. The FAA is not aware of any adverse reaction to this installation from the flying public. Thus, the FAA cannot justify the exclusion of upper torso restraints on the basis of commercial grounds in the future.

Removal of seats to provide adequate clearance between the seat and interior feature continues to be a very costly option. The FAA recognizes that the additional space

required to provide clearance between the front row seat and interior features is especially costly in smaller transport airplanes such as the Jetstream 4100, where a single row of seats is a significant portion of the total passenger capacity. Other solutions, such as padding, have not proven to be practical thus far.

The FAA considers the installation of airbags on airplanes a novel and unique feature, and is finalizing special conditions that prescribe appropriate criteria. Based on the comments received, it is unlikely that the final special conditions will change significantly from the published versions. Development of special conditions should not, therefore, have a pacing impact on the approval of such a system for the Jetstream 4100.

Given the relative maturity of the airbag system development, the FAA is concerned that a denial of this request might jeopardize completion of a program that has shown great promise. In addition, there would be a severe cost impact to operators, since the only available solution in the near term would be removal of seats. Therefore, given that the resultant product will likely provide a higher level of safety than might other means of compliance, the FAA considers that an extension of the existing compliance time is reasonable. As noted previously, the time requested allows for a lengthy service evaluation period. While this is a good idea, it could be accomplished in a much more expeditious fashion. The FAA has become aware that the hardware problems have been resolved. Given this fact, and the certification schedule, a nine month extension to the compliance time is considered adequate. This nine month extension also applies to the schedule for retrofit of the existing fleet.

In consideration of the foregoing, I find that a partial grant of exemption is in the public interest, and will not significantly affect the overall level of safety provided by the regulations. Therefore, pursuant to the authority contained in 49 US 40113 and 44701, formerly §§ 313(a) and 601(c) of the Federal Aviation Act of 1958 as amended, delegated to me by the Administrator (14 CFR 11.53), the petition of Jetstream Aircraft Limited for an extension to Exemption 5587 regarding the HI requirements of §§ 25.562(c)(5) and 25.785(a) of the FAR, for front row passenger seats on Jetstream Series 4100 airplanes, is granted until September 30, 1997, with the following provision:

The petitioner shall submit a schedule for retrofit of the design solution prior to the expiration of this exemption.

All other provisions of Exemption 5587, together with its conditions and limitations, remain the same and are applicable to this exemption. This amendment is part of, and shall be attached to, Exemption 5587.

Issued in Renton, Washington, on December 23, 1996

/s/
Stewart R. Miller
Acting Manager,
Transport Airplane Directorate,
Aircraft Certification Service, ANM-100

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